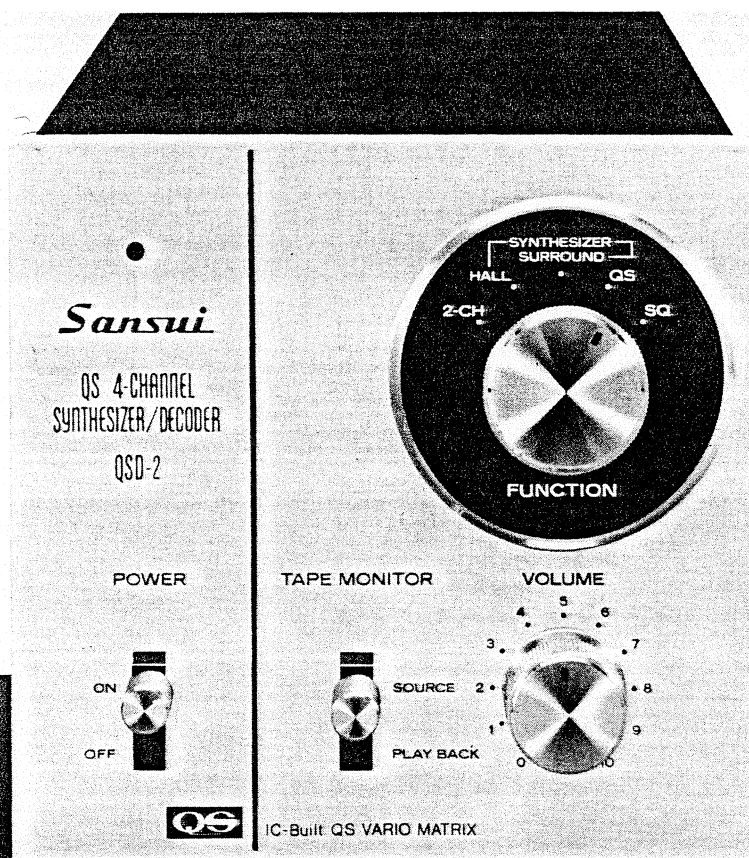


# SERVICE MANUAL

4-CHANNEL SYNTHESIZER DECODER

## SANSUI QSD-2



SANSUI ELECTRIC CO., LTD.

This service manual is designed for service engineers to repair, adjust, maintain and order the replacement parts of the QSD-2 correctly. When ordering the parts, use the stock number and parts name specifically referring to the Parts Location and Parts Lists. For general usage and maintenance of the unit, please refer to the Operating Instructions attached with the unit.

# 1. SPECIFICATIONS

## 4-CHANNEL DECODER SECTION

(TYPE-A QS VARIO-MATRIX)

FREQUENCY RESPONSE ...20 to 30,000Hz

DISTORTION .....less than 0.1% (at 1,000Hz)

SEPARATION

QS DECODER.....20dB (adjacent channels)  
30dB (diagonal channels)

QS Synthesizer .....equivalent to QS Decoder

INPUT SENSITIVITY

2-CHANNEL INPUT ....130mV

TAPE MONITOR(2-CH)...130mV

MAX. INPUT CAPABILITY...3V

OUTPUT LEVEL (at 1,000Hz)

4-CHANNEL OUTPUT

RATED .....730mV

MAX.....5V (0.5% THD)

TAPE REC.....130mV

## GENERAL

SEMICONDUCTORS .....25 Transistors, 8 Diodes,  
1 Zener Diode, 4 ICs, 1 LED

## POWER REQUIREMENT

VOLTAGE .....120V, 50/60Hz

CONSUMPTION .....4.5 watts

DIMENSIONS .....126 mm (5") W  
120 mm (4¾") H  
288 mm (11⅜") D

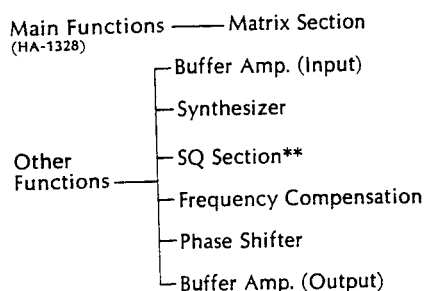
WEIGHT .....2.5 kg (5.5 lbs.) net  
3.3 kg (7.3 lbs.) packed

\* Design and specifications subject to change without notice for improvements.

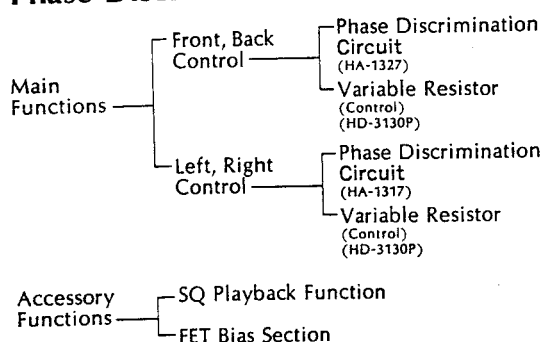
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## 1) Matrix Section



## 2) Phase Discriminator Section



## 2-3. Functions of QS Vario-Matrix Components

### 1) Matrix Section

#### ◆ Matrix

Computes the input signals in the form of  $(L+R)$  and  $(L-R)$ , then delivers four output signals ( $LF'$ ,  $LB'$ ,  $RF'$  and  $RB'$ ) according to the matrix coefficients provided by the control section, while creating maximum separation among the four signals.

#### ◆ Synthesizer

Blends L/R audio signals in phase (for QS Synthesizer/Hall function) or in reverse phase (for QS Synthesizer/Surround function) to produce LT/RT composite signals.

#### ◆ Phase Matrix (SQ Section)

A function for decoding SQ encoded signals. It is composed of phase shifters ( $\phi_1$ ,  $\phi_1+j$ ) for creating advancing 90-degree phase difference of a  $LT+RT$ , over an extended widerange of frequencies, and a gain control section that provides a  $LT+RT$  sum signal for separation control of the back channels.

#### ◆ Frequency Compensation

Compensates frequency response to stabilize the localization of reproduced sound images in the low and high frequency ranges:

Low frequency compensation—Designed to improve Front-Back separation in particular

High-frequency compensation—Designed to improve L/R separation in particular

#### ◆ Phase Shifters ( $\phi_2$ , $\phi_2+j$ )

There is one ( $\phi_2$ ) for the front channels, and another ( $\phi_2+j$ ) for the back channels. Together they help to reproduce the QS-encoded signals (LF, LB, RF and RB) in phase one another as they were in the original sound field.

## 2) Phase Discriminator Section

Detects the location of an input signal by phase-discriminating the phase and level differences between LT/RT QS-encoded signal, converts this information into DC levels, and sends it to the control section.

#### ◆ Front/Back Control

Controls the Front Left/Back left separation, and Front Right/Back right separation according to the phase difference between LT/RT QS-encoded signals.

#### ◆ Left/Right Control

Controls front left/right separation and back left/right separation according to the phase difference between  $LT+RT \angle -45^\circ$  and  $LT-RT \angle 45^\circ$ .

### 1. Phase Discrimination Circuit

Detects the phase difference between two input signals and delivers a DC output.

### 2. Variable Resistance Circuit (Control Section)

Changes the bias of the FET array IC (HD-3130P) according to the DC signal from the phase discriminator section. The conductance of the FETs then change continually to alter the matrix coefficients of the matrix section.

Fig. 7

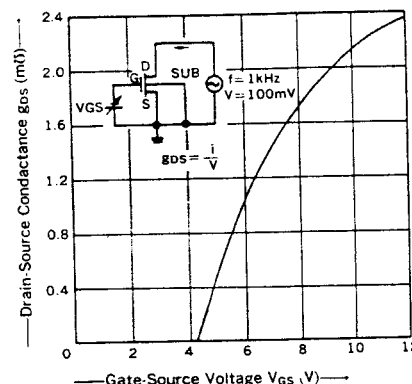


Fig. 7 shows the characteristic of the FETs inside the IC HD-3130P in terms of the gate-source voltage vs. drain-source conductance.

\*QS is a trademark of Sansui Electric Co., Ltd.  
\*\*SQ is a trademark of CBS Inc.

## 2. OPERATIONS (Refer to Block Diagram on Page 9)

### 2-1. Basic Operations of QS Encoder & QS Decoder

#### 1) QS Encoder

While a conventional stereo recording transmits L/R positional information in the form of relative level differences between L/R signals, the QS Encoder additionally transmits front/back positional information in the form of phase differences between L/R signals.

In other words, the QS Encoder is able to transmit signals in full 360-degree directions in an original sound field, by combining LT/RT amplitude differences (for storing left/right information) and LT/RT phase differences (for storing front/back information), and thus offers the advantage of being able to use all existing stereo transmission channels. Consequently, it is highly compatible with mono and stereo playback, yet provides outstanding high-fidelity 4-channel reproduction results. The conceptual diagram of the QS Encoder, and the mathematical equations behind it, are presented below:

Fig. 2 Conceptual Diagram of QS Encoder

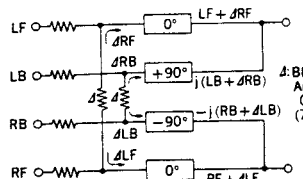


Fig. 1 Original Sound Field

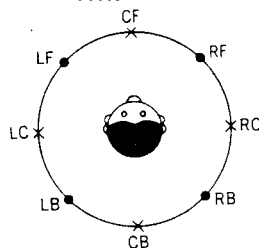
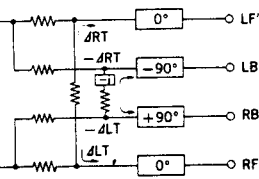


Fig. 3 Conceptual Diagram of QS Decoder



The encoder outputs (decoder inputs), LT and RT, are given by

$$LT = LF + \Delta RF + j(LB + \Delta RB) \quad RT = RF + \Delta LF - j(RB + \Delta LB)$$

The decoder outputs, LF', LB', RB' and RF', are given by

$$LF' = LT + \Delta RT \quad RB' = j(RT - \Delta LT) \\ LB' = -j(LT - \Delta RT) \quad RF' = RT + \Delta LT$$

The QS Encoder provided for aligning the QS Decoder provides the following outputs:

$$\begin{aligned} \textcircled{LF} \quad LT:RT=1:0.414 \quad (7.7\text{dB}) & \quad \textcircled{RF} \quad LT:RT=0.414 \quad (7.7\text{dB}):1 \\ \textcircled{CF} \quad LT:RT=1:1 & \quad \textcircled{CB} \quad LT:RT=1:1 \end{aligned}$$

The  $\textcircled{LF}$ ,  $\textcircled{RF}$ ,  $\textcircled{CF}$  and  $\textcircled{CB}$  represent sound sources in the original sound field.

#### 2) QS Decoder (Basic Matrix System)

By performing mathematical operations contrary to those accomplished by the QS Encoder, the QS Decoder provides output signals that have the same characteristics (level, phase, directionality) as the signals in the original sound field.

For example, an LF signal in the original sound field, which was encoded by the QS Encoder as  $LT=1$ ,  $RT=0.414$ , is now reproduced by the QS Decoder in the form of the following four output signals:

$$\begin{aligned} LF' &= LT + \Delta RT = 1 + (0.414)^2 = 1.171 \rightarrow 1.00(0\text{dB}) \\ LB' &= -j(LT - \Delta RT) = -j(1 - 0.414 \times 0.414) = -j0.828 \rightarrow -j0.707(-3\text{dB}) \\ RF' &= RT + \Delta LT = 0.414 + (0.414 \times 1) = 0.828 \rightarrow 0.707(-3\text{dB}) \\ RB' &= j(RT - \Delta LF) = j(0.414 - 0.414 \times 1) = 0 \rightarrow 0(-\infty\text{dB}) \end{aligned}$$

In other words, as Fig. 4 shows, the adjacent channels will have crosstalk of  $-3\text{dB}$  each, but the diagonally opposite channel will have no crosstalk ( $-\infty\text{dB}$ ).

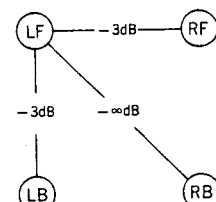


Fig. 4 Separation of QS Decoder

### 2-2. Basic Operations of QS Vario-Matrix Decoder (QSD-2)

The QS Decoder shown in Fig. 3 provides output signals that closely correspond, in terms of level, phase and directionality, with the signals in the original sound field, but it is the QS Vario-Matrix Decoder that eliminates the crosstalk to the adjacent channels and defines the location of each reproduced signal more clearly.

The QSD-2 QS Vario-Matrix Decoder performs various functions as outlined in the following paragraphs, and faithfully reproduces each and every one of the signals in the original sound field with greatly improved inter-channel separation as Fig. 6 shows.

The improvement in the inter-channel separation is a technical feature of the QS Vario-Matrix Decoder, and is accomplished by scanning and sensing the front/back and R/L direction of the predominant sound source, and varying the matrix coefficients accordingly from moment to moment (hence the name QS vario-matrix). At the same time, it has the advantage that lower-level sounds in all other directions are reproduced in full.

Fig. 5 Block Diagram of QSD-2

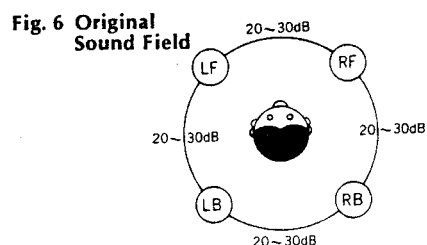
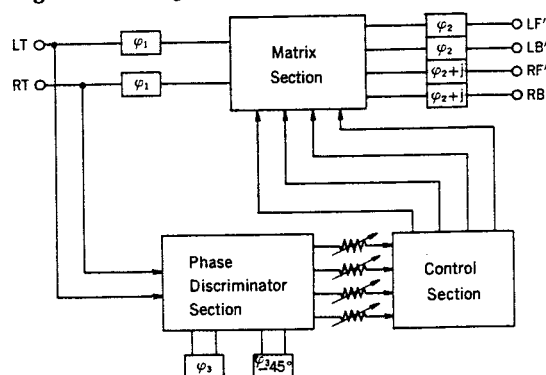


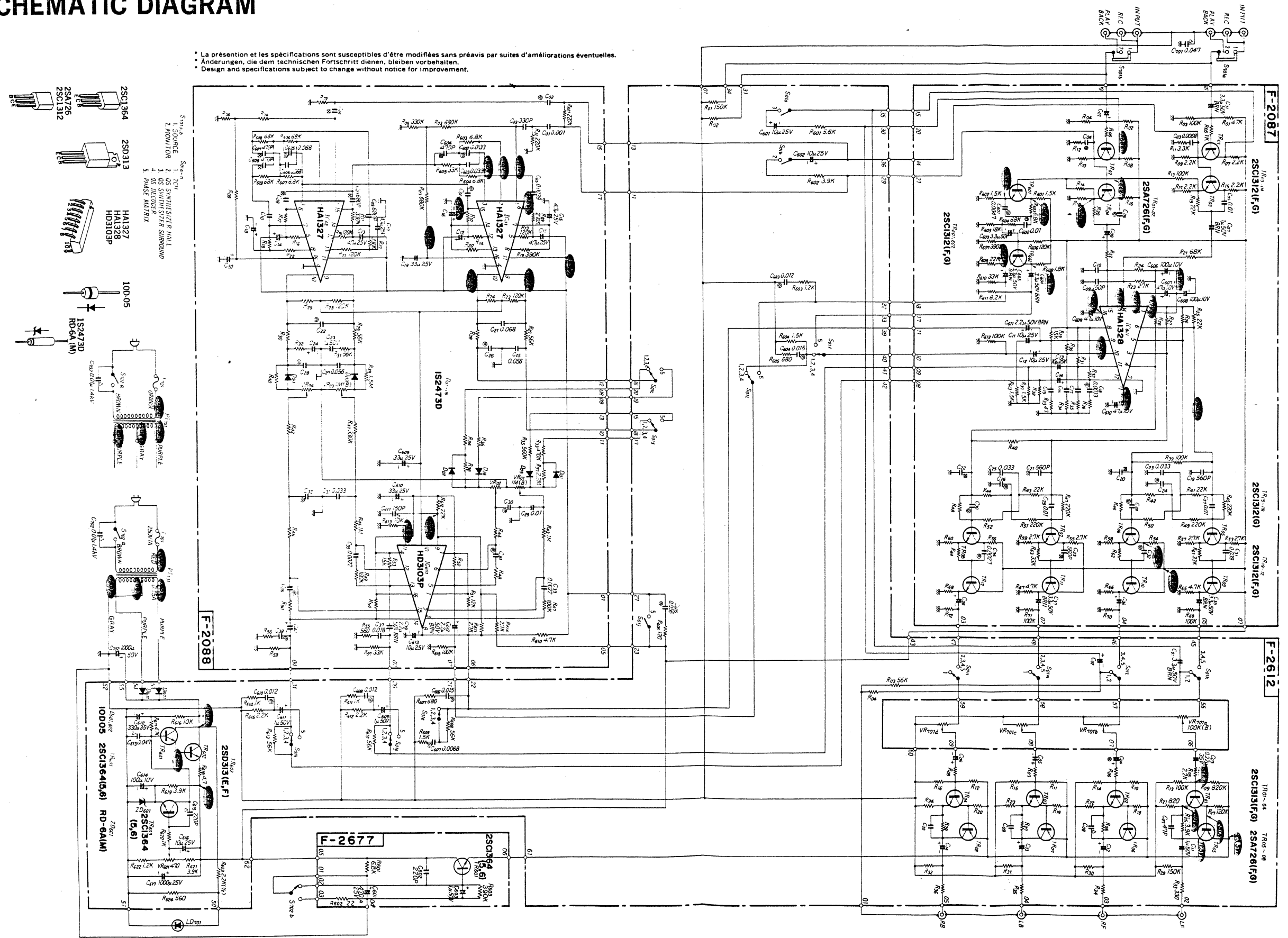
Fig. 6 Original Sound Field





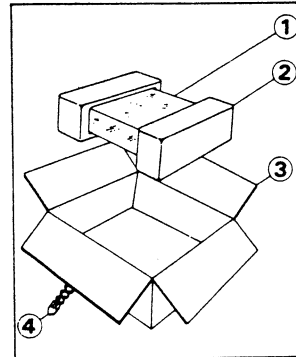
# 5. SCHEMATIC DIAGRAM

La présentation et les spécifications sont susceptibles d'être modifiées sans préavis par suites d'améliorations éventuelles.  
 Änderungen, die dem technischen Fortschritt dienen, bleiben vorbehalten.  
 Design and specifications subject to change without notice for improvement.



## 6. PACKING LIST

Parts No.	Stock No.	Description
1	9116042	Vinyl Cover
2	9027920	Styrofoam Packing
3	9009170	Carton Case
4	5996080	Curl Stopper



## 7. ACCESSORY PARTS LIST

Stock No.	Description
9209790	Operating Instructions
3810180	Pinplug Cord
9237370	Schematic Diagram

※ Regarding Adjustment methods of QS vario-matrix on QSD-2, refer to Service Bulletin, Ref. AN-087.